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Research Article

Percutaneous tracheostomy by Griggs technique: a retrospective analysis

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ABSTRACT

Background: The scope of percutaneous tracheostomy (PCT) is increasing with experience with successful conduct in conditions traditionally described as contra indications such as difficult anatomy, bleeding diathesis and high ventilatory requirement. The objectives of this study were to assess the safety of PCT in patients with obesity, short neck, thrombocytopenia, coagulopathy, high FiO_2 and PEEP requirement. We also aimed to determine complication rate and average time required.
Methods: This retrospective study was conducted in the surgical intensive care unit at a tertiary care centre. Seventy five patients who underwent PCT by Griggs technique, with ultrasonographic and bronchoscopic guidance during a period of one year from January to December 2014 were included. Age, sex, height, weight, BMI, platelet count, INR, crico sternal distance and duration of procedure were noted. We analyzed all high risk factors and peri procedural complications.
Results: Obesity was present in 5 (6.66%), short neck in 6 (8%), coagulopathy in 25 (33.33%), thrombocytopenia in 22 (29.33%), high FiO_2 requirement in 28 (37.33%) and high PEEP requirement in 30 (40%) patients. Minor complications were present in 11 patients (14.66%). No life threatening complications were noted. One patient required conversion into open tracheostomy. The average time taken for PCT was 4.87 ± 1.1 min.
Conclusion: PCT can be safely performed in patients with obesity, short neck, thrombocytopenia, coagulopathy and high ventilatory requirement with minimal complication rate, aided by tools like ultrasonography and fiberoptic bronchoscope.

Keywords: Percutaneous tracheostomy, Thrombocytopenia, Coagulopathy, Obesity, Short neck, High PEEP

INTRODUCTION

Percutaneous tracheostomy (PCT) is emerging as a popular method to secure a definitive airway in ventilated patients in critical care units as an alternative to surgical tracheostomy. It offers several advantages such as ease of performance, small skin incision, less tissue trauma, lower infection rate, bedside conduct as well as optimum utilization of ICU personnel.[1,2] The scope of PCT is increasing with training and experience, with successful management of more and more scenarios which were earlier perceived as contra indications. The present study was taken up with the objectives to evaluate safety of PCT in patients with difficult anatomy, bleeding diathesis and high ventilatory requirement, which are described as relative contra indications. We also intended to assess the complication rate and determine average time required.

METHODS

After obtaining approval from the institutional ethical committee, the present study was conducted in the

Surgical Intensive Care Unit (SICU) at a tertiary care centre. It was a retrospective study in which we reviewed the data of 75 patients who underwent PCT in SICU during a period of one year from January to December 2014. Patients in whom PCT was performed for prolonged mechanical ventilation, airway protection against aspiration or prolonged tracheal toilet in view of severe head injury, ARDS and weaning failure were included in the study. Patients with unstable cervical spine fracture, platelet count (PC) <60000/mm^3, International Normalized Ratio (INR) >1.7, those requiring FiO_2 >0.8 and PEEP >12 cm H_2O were excluded. The data was collected from the tracheostomy log book and case notes. Demographic variables - age, sex, height, weight, Body Mass Index (BMI) and Crico Sternal Distance (CSD), investigations - platelet count and INR, ventilatory parameters - FiO_2 and PEEP value were noted. High risk patients were defined as those with short neck (CSD <2 cm), obesity (BMI >30 kg/m^2), thrombocytopenia (PC 600000-100000/mm^3), coagulopathy (INR 1.3-1.7), FiO_2 requirement 0.6-0.8 and PEEP requirement 8-12 cm H_2O. Ultrasonography (USG) of the neck was performed prior to the procedure. Anaesthesia was provided with intravenous fentanyl, propofol and atracurium infusion. Ventilation with FiO_2 1 was continued along with continuous monitoring of vitals. Neck was extended with a roll placed between the shoulders. Strict aseptic precautions were followed. Skin was infiltrated with 2% lignocaine in adrenaline, midway between cricoid and suprasternal notch, corresponding to the space between second and third tracheal rings. A horizontal incision, 1-1.5 cm, was made with scalpel and the subcutaneous tissue was separated up to pretracheal fascia using haemostatic forceps. Endotracheal tube (ETT) was withdrawn by the assistant under direct laryngoscopy till the cuff was just below the vocal cords. PCT was performed by Griggs technique. Trachea was located by aspirating air using 14G cannula introduced in caudal direction. The guide wire was introduced in trachea, followed by 14 Fr dialator. Fully closed metal tracheal dialating forceps were passed over the guide wire and opened just enough to accept Tracheostomy Tube (TT) and withdrawn in semi open position. Tracheostomy tube was railroaded over the guide wire. Every step was confirmed by fiberoptic bronchoscope (FOB). The duration of procedure, from skin incision to insertion of tracheostomy tube, was noted. The position of TT was confirmed by X-ray chest. Incidence of minor as well as major peri operative complications (within 24 hours) was noted.

A detailed statistical analysis has been carried out in the present study. Data analysis was performed using SPSS version 21. Continuous measurements (age, sex, height, weight, BMI, crico sternal distance, duration of procedure) are presented as mean ± SD and categorical measurements (incidence of high risk factors, minor complications and major complications) are presented in number (%).

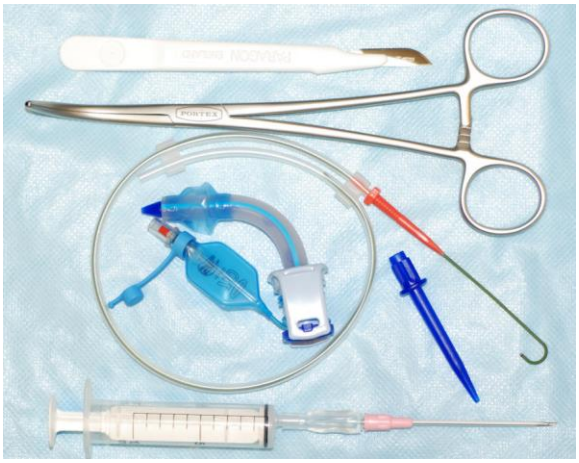

Figure 1: Portex Griggs percutaneous dilation tracheostomy set, Smiths medicals.

RESULTS

PCT was performed in 75 patients during the period of one year, out of which 49 were males and 26 were females. The average time required for the procedure was 4.87 ± 1.1 min (Table 1).

Table 1: Demographic data.

Parameter	Mean
Age (years)	41.12 ± 12.72
Sex (M/F)	49/26
Weight (kg)	65.85 ± 8.84
Height (cm)	162.47 ± 7.47
BMI (kg/m^2)	24.93 ± 2.86
Crico sternal distance (cm)	2.63 ± 0.42
Duration of procedure (min)	4.87 ± 1.1

The number of patients with high risk factors was 39, amounting to 52% of the study population. Obesity was present in five (6.66%), short neck in six (8%), coagulopathy in 25 (33.33%), thrombocytopenia in 22 (29.33%), high FiO_2 requirement in 28 (37.33%) and high PEEP requirement in 30 (40%) patients (Table 2).

Table 2: Incidence of high risk factors.

Risk factor	Number	%
Obesity	5	6.66
Short neck	6	8
Thrombocytopenia	22	29.33
Coagulopathy	25	33.33
FiO_2 0.6-0.8	28	37.33
PEEP 8-12 cm H_2O	30	40
Total high risk patients	39	52

Minor complications were present in 11 patients (14.66%). Minor bleeding was the commonest complication, present in five (6.66%) patients. Technical difficulties constituted accidental puncture of ETT cuff in

one (1.33%) patient and difficulty in railroading of the TT over guide wire in two (2.66) patients (Table 3).

Table 3: Incidence of minor complications.

Complication	Number	%
Minor bleeding	5	6.66
ETT cuff puncture	1	1.33
Difficulty in TT introduction	2	2.66
Transient hypotension	3	4
Desaturation SpO_2 <85%	0	0
Accidental extubation	0	0
Subcutaneous emphysema	0	0
Tracheal ring fracture	0	0
Total	11	14.66

We did not encounter any life threatening major complication. In one patient, the procedure was abandoned and converted into open tracheostomy which amounted to 1.33% (Table 4).

Table 4: Incidence of major complications.

Complication	Number	%
Major haemorrhage	0	0
False passage	0	0
Posterior tracheal wall injury	0	0
Oesophageal perforation	0	0
Pneumothorax	0	0
Cardiac arrest	0	0
Conversion to open	1	1.33

DISCUSSION

Percutaneous tracheostomy has revolutionized the process of establishing a definitive airway at bedside in critically ill patients by intensivists. PCT was first described by Sheldon in 1955 using a cutting trochar and the procedure has thereafter evolved over years. Ciaglia described a technique using serial dialators over a guide wire in 1985 and Griggs et al. developed one stage dialatation technique using a modified Howard-Kelly forceps as tracheal dialator in 1990.[1,2] In view of familiarity, experience and cost, Griggs technique of PCT using a commercially available kit (Portex Griggs percutaneous dialation tracheostomy set, Smiths Medicals as in Figure 1) has been the standard technique in our SICU.

The status of PCT suffered several setbacks due to unacceptably high complication rates in the initial period. This reflects inadequate training and lack of familiarity with the technique, especially during the learning curve.[3] PCT has proven to be a safe and effective technique in experienced and well trained hands.[4]

Literature has described cervical injury, pediatric age, high ventilatory support, uncontrolled coagulopathy and emergency airway necessity as absolute contraindications. Whereas difficult anatomy due to short neck, obesity and prior tracheostomy as relative contraindications.[1-5] However, the perceived contraindications are decreasing with experience, as suggested by recent reports. Most contraindications should be viewed as suggestions related to the skill, training and experience of the performer.[3,4]

In the present study, we could perform PCT safely in 22 patients with low platelet count and 25 patients with high INR after transfusion of platelets and fresh frozen plasma at discretion of the treating physician. We did not find any association with minor or major bleed in these patients. Recently, studies have suggested that PCT may be safely performed in patients with coagulopathy, thrombocytopenia and those on heparin infusion.[6-9] It has been suggested that a smaller incision required for PCT and the tamponade effect of TT may prove advantageous in patients with borderline correctable coagulopathy. Bleeding complication rates associated with PCT vary, with a reported incidence from 0 to 12%.[9] Kluge et al[8] reviewed 42 patients with thrombocytopenia (platelets less than 50000/mm^3) who underwent PCT using Griggs method with bronchoscopic guidance and reported that this approach is safe in this group of patients. Study by Blankenship et al included nine patients with a total of ten coagulopathic conditions (seven with INR >1.5, two on heparin drip and one with PC <20000) who underwent PCT without any complications.[6]

Morbid obesity, short neck, limited neck extension and history of prior tracheostomy were perceived as contra indications due to the difficulty in identification of anatomical landmarks. This view is no longer supported with the use of aids like USG and FOB which together help in overcoming technical difficulties. Various retrospective studies have suggested that PCT may be performed safely in these patients.[5,6,10,11] This was corroborated by our study as we could perform PCT without any difficulty in five obese patients and six patients with short neck. Retrospective study by Blankenship et al included seven morbidly obese patients with a mean BMI of 64.4 and a mean weight of 184.9 kg in whom PCT was performed safely.[6] If the neck anatomy is palpable and the cricoid cartilage is at least about 1.5 cm above the sternal notch, PCT can be performed safely in most cases. Once the soft tissue of the neck is pulled in the cephalad direction, tracheal anatomy and location can be identified in nearly all obese patients. It has been observed that truncal obesity does not correlate with the palpability of the tracheal rings. Nevertheless, the skin to tracheal distance in these patients could be as high as 4-5cm and an extended length tracheostomy tube may be better suited.[10]

Although high ventilatory requirement has been listed as a contra indication, we found PCT a safe technique in patients with FiO_2 0.6-0.8 and PEEP 8-12 cm H_2O. Experience of the performing intensivist and swift

performance of the procedure would have contributed to safety in the patients. Hypoxia from the loss of PEEP can be further prevented by performing the neck dissection and identifying the needle insertion site first. The endotracheal tube can be then retracted and the needle inserted. From needle insertion to the placement of the tracheostomy tube usually takes less than a minute in expert hands. By applying pressure over the stoma, the loss of PEEP can be minimized.[5,7,10-12] It is advisable to delay PCT in patients with borderline oxygenation on an FiO_2 0.8 and PEEP 15cm H_2O.[7] But literature reports safe conduct in patients on more than 20 cm H_2O PEEP.[12]

Fractures of cervical spine make both surgical and percutaneous technique more complex. Inability to extend the neck, presence of recent surgical scar and presence of external fixator device contribute to the difficulty. In these patients, gentle rostral traction on the larynx in neutral neck position helps in a better surgical exposure.[11,13,14] Recent literature suggests that PCT is safe and feasible in cervical spine fractures as well as trauma patients without cervical spine evaluation. There is no evidence of PCT related neurological complications and PCT is found to be comparable to surgical tracheostomy.[15,16]

Marelli et al first described bronchoscopy as an adjunct to PCT for improving safety. A lower incidence of complications is cited with the use of FOB by avoiding injury to adjacent structures including neck vessels and paratracheal insertion. It also helps to confirm tracheal midline and presence of guide wire, dilator and tracheal cannula inside the tracheal lumen. It is essential to confirm that guide wire is not through Murphy eye or posterior tracheal wall into the oesophagus. Visualization of mucosal injury, tracheal wall abnormality and prior vocal cord or subglottic injury may be useful in evaluation of long term complications.[3,4,11,17] But use of bronchoscope may impair ventilation and delivery of PEEP resulting in derecruitment, desaturation, hypercarbia and raised intra cranial pressure.[1,4,11] It also necessitates presence of three clinicians.[1] We advocate routine use of fibreoptic bronchoscope guidance. Ours being a teaching institute, we perform PCT in a team comprising of two intensivists and one resident trainee.

Several complications have been described as a consequence of PCT. They are categorized as minor (minor bleeding, hypotension, desaturation, accidental extubation, subcutaneous emphysema, tracheal ring fracture, technical difficulties) and life threatening major ones (major hemorrhage, false passage, puncture of post tracheal wall, oesophageal perforation, pneumothorax).[1,2] Various meta-analysis have found the complication rate associated with PCT to be lower or comparable to surgical tracheostomy.[17-19] Higgins et al.[18] studied 15 studies in their meta-analysis and reported a trend towards lower complication rate but higher accidental decannulation associated with PCT. Delaney et al.[19] conducted a meta-analysis of 17 studies and found a lower wound infection rate with PCT as compared to surgical technique, but no difference in bleeding and other complications. The complication rate associated with PCT reported in literature varies from 2.1% to more than 20%. Several large cohort studies have reported a major complication rate of 5%.[2] The incidence of minor complications was found to be 14.66% in the present study. We did not encounter any life threatening complications which may be attributed to the small sample size.

The commonest complication was minor bleeding which was controlled with adrenaline soaked gauze. It was observed that it was not related to the presence of bleeding diathesis. We encountered technical difficulties in 3 patients. In one patient, the cuff of endotracheal tube was punctured on needle insertion as the tube was not withdrawn adequately. Railroading of tracheostomy tube was difficult in 2 patients as the guide wire was kinked. It was noted that technical difficulties occurred more for beginners, emphasizing the importance of supervision and controlled settings for training.

In one patient we failed to access the trachea due to the enlargement of thyroid isthmus, which was not appreciated prior to procedure. We had to abandon the procedure and perform tracheostomy by open surgical technique. Thereafter, we started performing USG neck prior to procedure. This helped us in locating the anatomy of tracheal rings as well as thyroid gland and major blood vessels, further enhancing safety of the procedure.[4,11]

Late complications like infection, wound breakdown, skin scarring, trachea-oesophageal fistula and tracheal clot have been reported.[1,2] We limited our study to peri operative complications as we found it difficult to study long term complications due to critical condition of patients and difficult follow up of survivors in our setting. Further studies are required to define these complications and prospectively study long term survivors after tracheostomy.

A high incidence of decannulation and obstruction[5] associated with PCT necessitates more intensive nursing care. We should be more cautious to reduce the possibility of dislodgement of tracheostomy tube.

Bedside procedure eliminates the risk of transporting unstable patients and avoids critical incidents. It also eliminates logistic problems as well as procuring slot in already overburdened operation theatre schedule.[1-4] An added advantage is a short duration of the procedure. In our study, the average time required was 4.17 ± 1.1 min.

Traditionally PCT is considered an elective procedure. But reports of PCT in emergency settings have emerged with encouraging results. Studies have highlighted a possible role for PCT in airway emergencies such as inability to intubate or ventilate. Adequate training and

experience can ensure application in emergency situations.[11,20,21]

There are few limitations of our study. The number of patients included in the study was small. We analyzed individual risk factors, whether more than one complication occurred in a single patient was not studied. We did not analyze the effect of more than one risk factor on incidence of complications. Also, we limited the study to peri operative complications, delayed and late complications were not observed.

Future research may include prospective studies evaluating delayed and late complications which will be valuable. The role of PCT in cervical spine injuries and airway emergencies also needs to be proved.

To summarize, PCT can be safely performed in selected patients having difficult anatomy, bleeding diathesis and high ventilatory support, though traditionally described as contra indications. This is made possible by appropriate selection of patients, correction of reversible risk factors, expertise and experience. Ultrasound and fibreoptic guidance enhance safety of the procedure and minimize complications in these high risk patients.

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